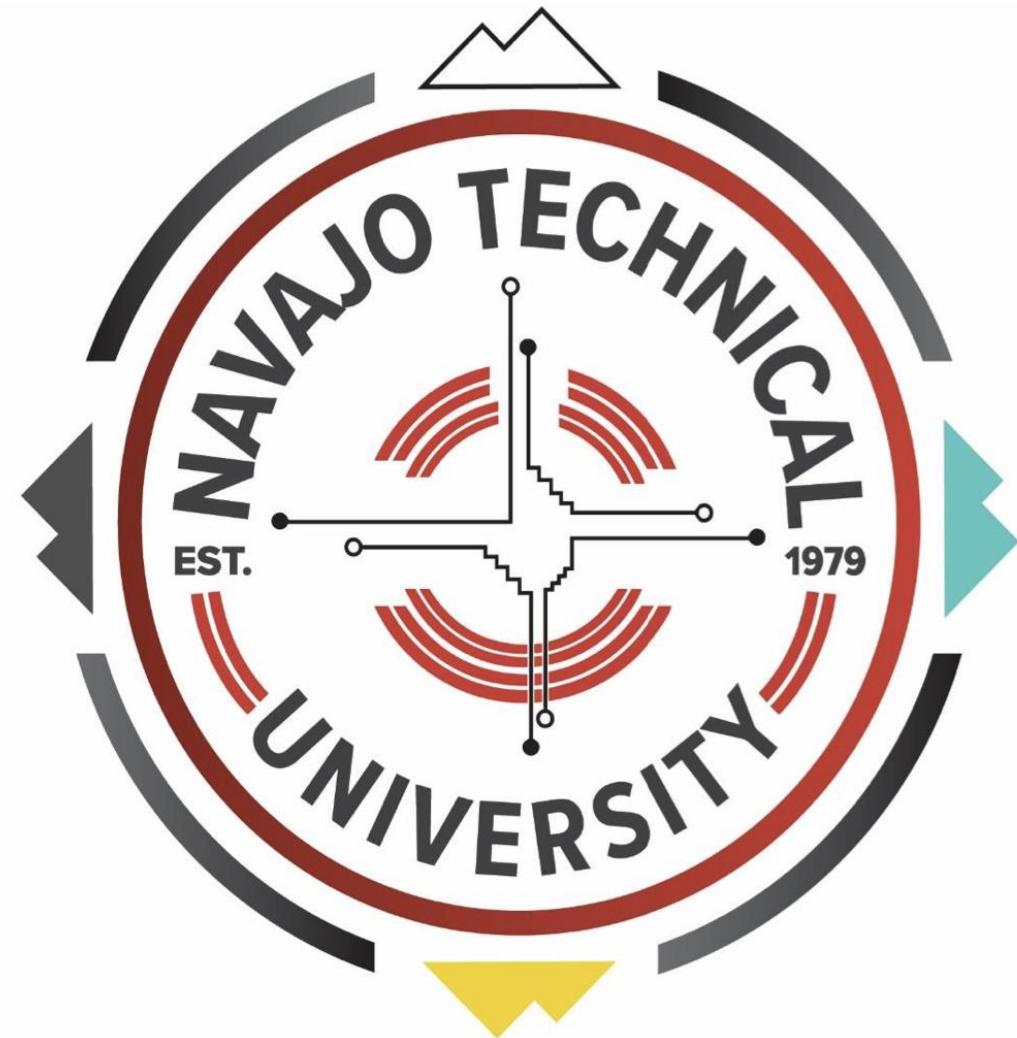
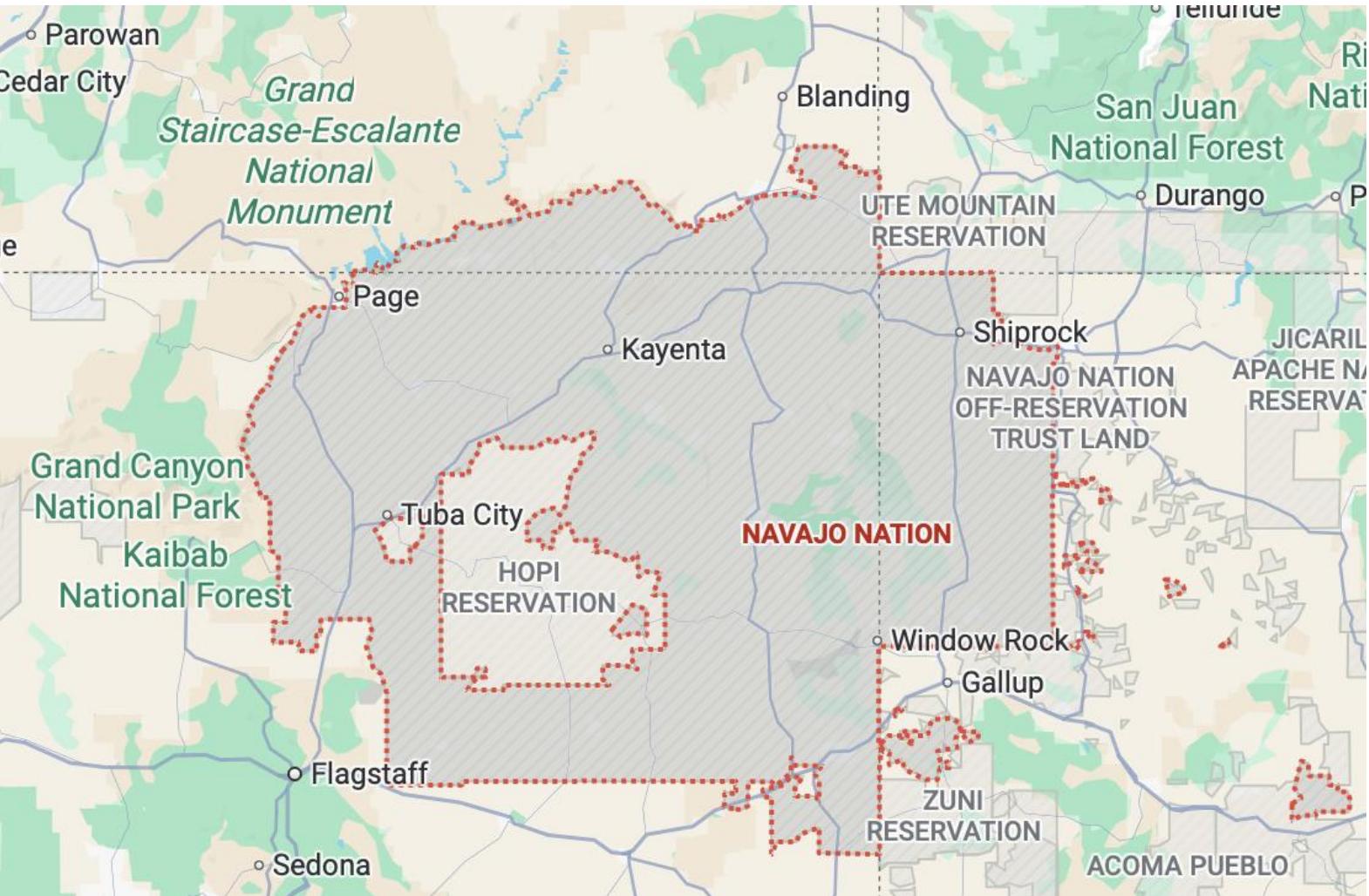


Navajo Technical University

Dr. Sundaram Arumugam
Associate professor
Electrical Engineering



Navajo Nation



Energy availability is a significant challenge in the Navajo Nation

Approximately 13,000-14,000 house lacking electricity

- vast geographical distances
- Poverty
- high connection costs

Residents often rely on alternative power sources like

- kerosene
- diesel generators
- solar panels

Solar panels - Navajo nation

Solar panels for Navajo Nation houses are sponsored by a combination.

- Federal, state, and private entities, including
- U.S. Department of Energy (DOE)
- U.S. Department of Agriculture (USDA),
- Private companies like Qcells and Navajo Transitional Energy Company (NTEC), and non-profit organizations such as Native Renewables.
- These sponsors provide grants, equipment donations, and funding for installation to electrify homes.

Navajo Technical University

Certificate Programs

Associate programs

Bachelor Degree Programs

Masters Degree Programs

PhD Program

NTU Electrical Engineering

B.S.EE – ABET Accredited program

M.S.EE – HLC Approved

PhD – Yet to Start

Navajo Technical University

- Construction of Gazebo at NTU campus with Solar Panels



A Study on a Solar Panel installation and Operation as a part of curriculum at a Navajo Nation House.



U.S. Department of Energy's Solar Decathlon Competition

- Electrical student Edwina Lesli Presented the design paper in the completion
- Martin Keller, The director of National Renewable Energy laboratory and With David M.Turk Deputy Secretary of the US Department of Energy.



“Off-Grid Solar Powered system implementation on the Navajo Nation”

Off-Grid Solar Powered system implementation on the Navajo Nation.
 Strawberry Livingston¹, Dr. Henry Louie²
 Electrical Engineering Department, Navajo Technical University,
 Seattle University²

Abstract
 Approximately 30 percent of the population on the Navajo Nation (NN) are still without electricity¹. Connecting a home to the electrical grid is not an option for many Navajo families. This paper highlights the challenges of connecting to the grid and the cost of electricity reflects towards existing distribution lines near homes that require minimal materials and personnel to implement these connections. These challenges are compounded by the fact that the Navajo Nation does not have a reliable power grid. This paper highlights the increase from the homes that need electrification. Since the four corners region has an exponential increase in Peak Volt (PV) arrays, the Navajo NN would benefit to have an off-grid sovereign nation and help support energy as a community or even individuals that are remote from main grid connections.

Introduction
 As an objective for this project, students were required to create a company to implement a PV system at any location selected by the students. The students were given budgetary guidelines for money to establish a PV system in a new home, commercial business or other establishments that can stay within the budget. These systems must take into account the following: location, solar insolation, daily loads, selection of inverters, battery bank selection, charge controllers, tilt and insulation, PV module selection and prices of components.

Method
 Fig. 1 shows an image of the proposed location in Blanding, New Mexico. The image is taken from Google Earth Pro to Google reference the location using the latitude and longitude, which was used to find the insolation of the area utilizing the NASA POWER prediction application. Latitude and Longitude of the location is, 35° 24'03.25" N; 108° 43' 24.95" W.

Equations
 Inverter calculations
 Inverter power requirement = Peak power x (1 + design margin)
 Max.inverter DC current = $\frac{\text{Required inverter power}}{\text{Nominal battery voltage} \times \text{inverter efficiency}}$

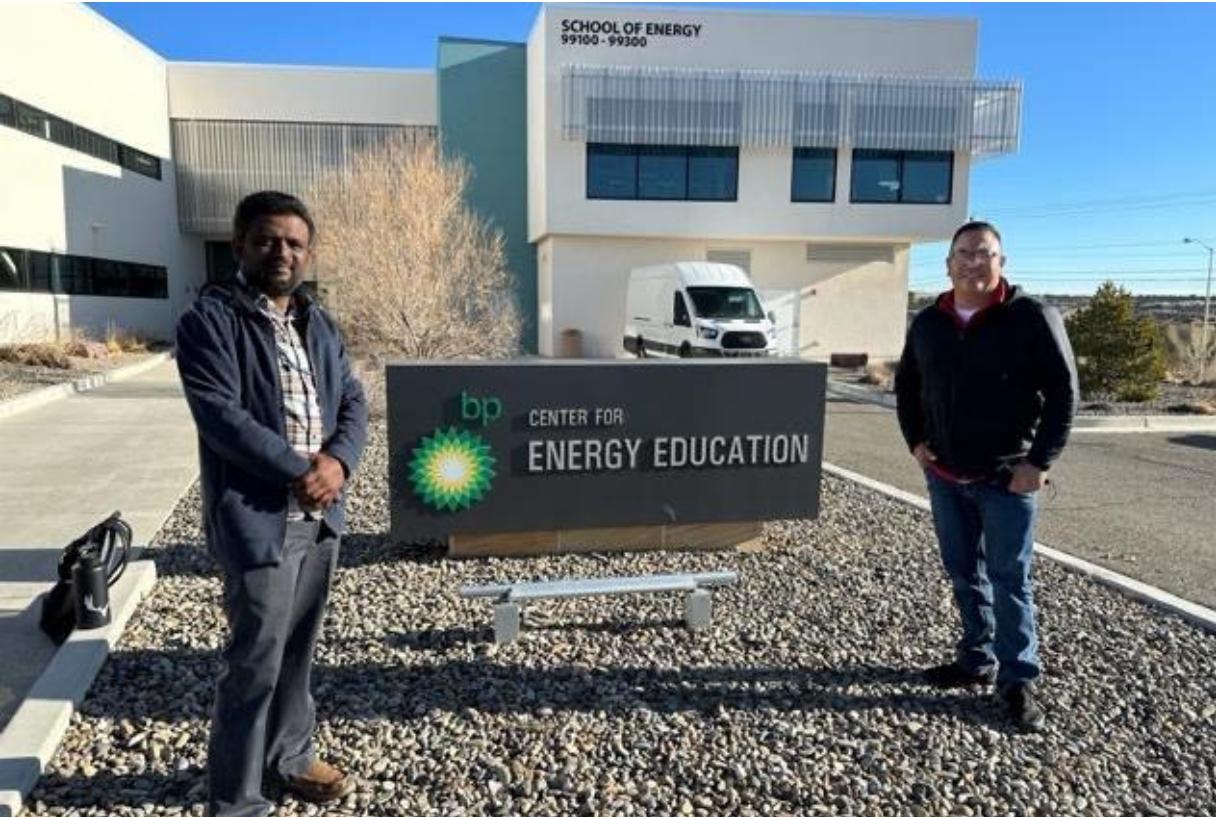
Battery Bank Calculation
 Average battery load = $\frac{\text{Avg. Daily Load}}{\text{Inverter efficiency} \times \text{Nominal battery Voltage}}$
 $C_s = \text{Days of Autonomy} \times \text{Avg. Battery Load} \times \frac{1}{\text{End of life rating}}$
 $C_r = \text{Rate of } \frac{\text{Max inverter current}}{\text{Nominal current}}$
 $C_s = C_r \times \frac{\text{DOD}_{\text{min}}}{\text{DOD}_{\text{max}}} \quad \text{DOD}_{\text{min}} = \text{Typically 50% - 80%}$
 $DOD_{\text{max}} = 100 \times \frac{\text{Average battery load}}{C_s}$
 $C_s = C_r \times (1 + \text{Battery Design margin})$
 $\text{Number of series Batteries} = \frac{\text{Required bank Nominal Voltage}}{\text{Battery Nominal Voltage}}$
 $\text{Number of battery strings} = \frac{\text{Required battery bank capacity}}{\text{Battery Capacity}}$

Results
 Once the parameters of the PV modules have been calculated and matched the charge controller specifications, we obtained the following: 18 modules in total with 6 strings of 3 modules in series. The series modules open circuit voltage total is 120.3 V with a short circuit current of 17.7 A. The open circuit voltage is safe to say that the voltage is within the max input, but the current is high. So, two charge controllers were selected and the PV modules were separated in half. The final configuration of the PV modules is 3 strings with 3 in series for each charge controller.

Conclusion
 With more education and advocacy for off grid PV systems it would alleviate some stress on dependence for natural resource consumptions. It would also create the Navajo Nation to become more energy sovereign and help with sustainability in our community and across the world.

CITES

- [1]Blauster Tanana and Virginia Borromeo, "Emerging Navajo Nation: How Education can secure a sustainable future for Indian country", Brookings, Wednesday May 14, 2014.
- [2]Henry Louie, "off-grid electrical systems in developing countries", Springer, 2018.



Minority Serving Institution Partnership Program (MSIPP) – Annual Meeting

“Radiation Detection on
Abandon Uranium Mines
on the Navajo Nation”



Tribal Colleges and University Program Research Symposium

- The students presented posters on various research topics.
- This symposium - growth of STEM and research.



NTEC Navajo Mines A3 Farmington, NM

- Navajo Tech Students visit NTEC Navajo Mines A3 Farmington, NM
- opportunity to interact with industry experts.
- understand energy management



Navajo Nation, Energy Summit 2024



Energy Generation: Topics

- **Oil and Gas**
- **Hydrogen**
- **The Importance of the Grid & Transmission, Energy Education Opportunities**

50th IECON (Institute of Electrical and Electronics Engineers) conference – IEEE conference

- **“Improving Indoor Air Quality Using a Box Fan Filter in for Navajo Nation Home - Healthy Hooghan Project”**
-



10th Annual
Tribal College
Research
Symposium was
conducted at
Bismarck.



AIHC The American Indian Higher Education Consortium (AIHEC)



The conference featured a range of workshops, presentations, and networking opportunities, focusing on various topics



ENERGIZED WATERSHED PANEL

GOAL: By 2035, the Energized Watershed Engine is a ***national*** and ***global commercial hub*** for water security and energy technologies — accelerating market-ready innovations through deep collaboration among industry partners, regional R&D institutions, Tribes, community members across the region, and investors.

GOVERNOR'S 50-YEAR WATER ACTION PLAN

Water conservation

- A1 Public education campaign
- A2 Agricultural water conservation
- A3 Municipal conservation
- A4 Water storage and delivery

New Water Supplies

- B1 Desalination and water treatment
- B2 Expand potable and non-potable water reuse
- B3 Groundwater mapping and monitoring

Water and Watershed Protection

- C1 Clean-up contaminated groundwater sites
- C2 Control discharge through permitting
- C3 Modernize wastewater treatment plants
- C4 Protect and restore watersheds

Panel Members



David Hanson



Stephen Gomez



Alex MAYER



Ken Armijo



Sundaram Arumugam



Kurt Solander

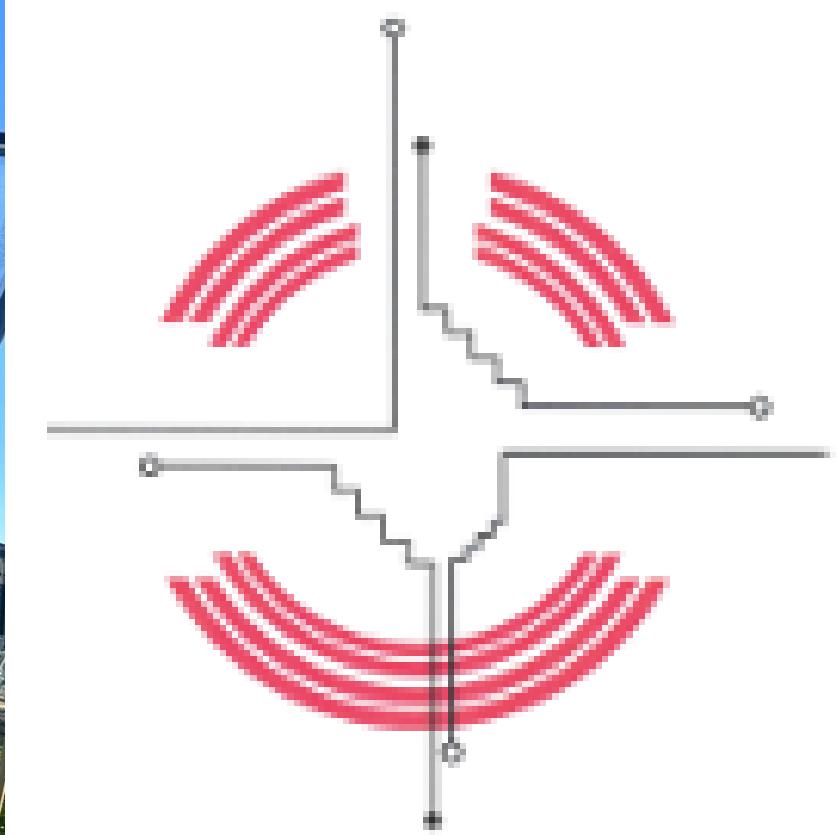
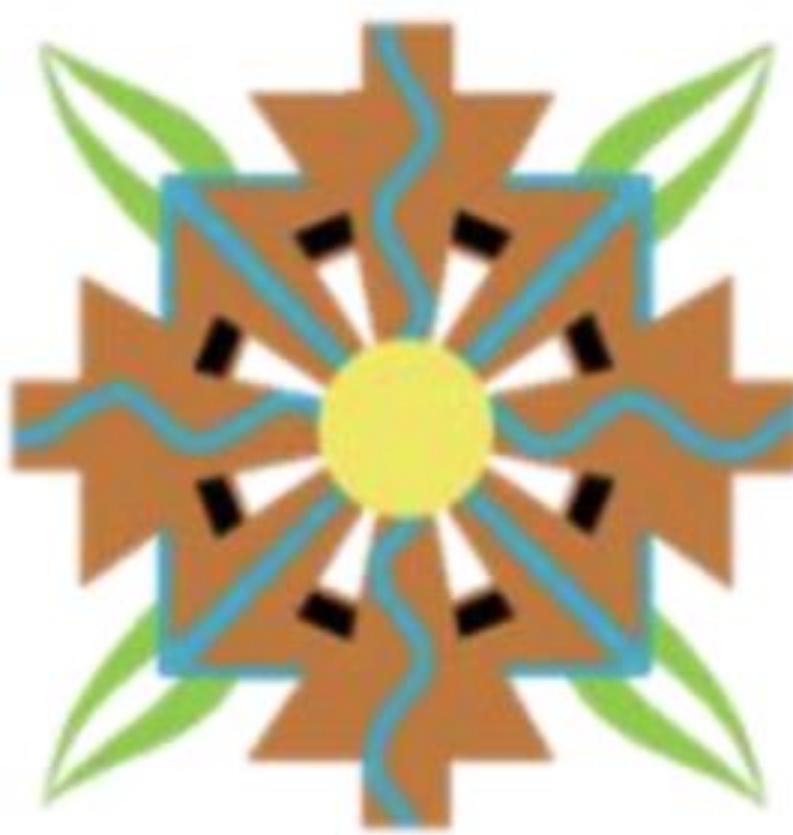
Navajo Technical University - Students

Explores Sustainable Agriculture
and Indigenous Culture in Rio
Grande Community Farm,
Albuquerque



NTU Garden Farming





Hands-on Agrivoltaic
Microgrid Solar Panel
Characterization Workshop
at UNM Campus.
Albuquerque

- Gain practical, hands-on experience in renewable energy systems through our immersive Agrivoltaic
- Microgrid Solar Panel Characterization training.

Summer STEM skill program is conducted every year for the school students and they were trained to handle the tools and use the equipment's in a safe manner.





JOIN US AT THE 2025 N⁴WPP WATER SYMPOSIUM!

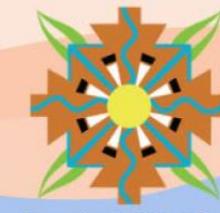
OCTOBER 24TH 2025

NAVAJO TECHNICAL UNIVERSITY
LOWERSPOINT RD STATE HWY 371, CROWNPOINT, NM 87313

HIGH SCHOOL STUDENTS WILL LEARN ABOUT WATER QUALITY AND SUSTAINABILITY THROUGH A SERIES OF HANDS-ON ACTIVITIES

WE ARE LOOKING FOR ORGANIZATIONS THAT WOULD LIKE TO INTERACT WITH BOTH THE COMPETING HIGH SCHOOL STUDENTS AND THE NTU COLLEGE STUDENTS ALREADY ON CAMPUS

INTERESTED? CHECK OUT OUR WEBSITE TO REGISTER AND LEARN MORE ABOUT THE 2025 EVENT!



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Commitment to Stewardship

NEW MEXICO TECH
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Navajo Tech - New Mexico Tech - Navajo Nation Water Purification Project



Thank you